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**A TEST OF CONDITION: PRELIMINARY REPORT.**

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*Introduction.*—This report is given to the medical profession in its preliminary stage, after the work of a year and a half; so that it may become immediately available for use and perhaps the earlier subject to modification and improvement. The importance of the principle involved, however, cannot be overestimated.

*Importance.*—There does not exist to-day a reliable test of condition, although its need is felt in very many quarters. The physician would be glad to know accurately what the real condition or relative degree of health is in the patient who comes under his care for the first time. It is of the utmost importance for him to know to what extent the trouble complained of affects the general health and vitality. It would give him a real guide on which to base his advice to the overworked or run-down in prescribing a treatment of tonic, rest or exercise. It would give him a real method of determining the increase of health resulting from such treatment. "Feelings," cannot always be relied upon. To the prospective employer, military, civic or mercantile, the condition of the applicant, if accurately determined, would be of vital importance. To the psychologist an accurate test of this sort would serve as a basis for definite comparisons between mental and physical efficiency, at present almost an impossibility due to the meager information of physical condition obtainable by the tests now in use. To the educational expert.

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it would give a basis for determining the effect of the various hygienic or unhygienic features of our modern school curriculum. To the physical trainer, the worker in practical hygiene, it would give a means of noting actual progress in the most important part of his work and of measuring his success in producing the condition of health. To the athletic instructor, the coach, the oarsman and the prize-fighter it would furnish what had long been sought, an indication of success of methods of training.

During the course of an investigation on the effects of muscular contraction on blood pressure the writer elaborated a test that promises to be useful in the way indicated. In brief, the test consists in the comparison of the systolic blood pressure and the heart rate of the recumbent position with those of the standing position. The physiology involved is as follows:

On assuming a standing position the voluminous splanchnic veins are constricted by the vasomotor action of the splanchnic nerves. If this contraction is effective against the increased pressure brought to bear through the gravity, the blood pressure in the upper body rises. If it is ineffective, it fails to rise or actually falls. This accounts for the great disparity of opinion on this point, some observers finding a regular rise of 10 to 15 mm., others finding no average change, others a fall, when the standing position is assumed after the recumbent. This is an indication therefore of the efficiency of the splanchnic vasomotor mechanism which is not only important but essential to life. Upon its successful working depends the blood pressure in the brain, on the maintenance of which depends not only consciousness but the working of every function of the body and even life itself.

This mechanism is the latest in the body to



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develop, appearing as it has only after man has taken to the erect position. It is very easily wearied by lack of sleep, by work and by any unhygienic proceedings in general; even the routine of our daily life exhausts it to a greater or less degree. The *total* abrogation of its functions leads to the accumulation of the blood in the abdomen, the exsanguination of the rest of the body, and death. It is a very fair presumption that the working of this most important function upon which depends blood pressure, the distribution of the blood, and the working of the brain will be an indication of the condition of the body as a whole and an index to its general efficiency.

Should this be so, we shall have arrived at the end of our investigation and it will only remain to observe the rise or fall of the systolic pressure to estimate the condition of the individual. Another factor, however, enters into consideration. When the blood pressure tends to fall, the heart rate is accelerated. This is associated with a rise in pressure which masks the inefficiency of the splanchnic contraction. This is apparently a conservative mechanism in the nature of a second defence against a fall of blood pressure. Clearly then we must take into account the amount of acceleration of the heart as well as the rise or fall of blood pressures when we estimate the amount of relative failure of the splanchnic contraction.

This state of affairs in our ideal "condition" would be, a maximal rise of blood pressure with no acceleration of the heart on standing, evidencing such a complete working of the splanchnic mechanism that the heart would not be called to help raise the blood pressure. When, however, we observe the same rise of pressure accompanied by the increase of heart rate we must infer a

relative insufficiency of the splanchnic mechanism on account of the calling of the heart to help. Hence a poorer condition. Similarly, we would not consider the splanchnic mechanism as failing so badly should the blood pressure fall alone as in case it should fall and the heart be considerably accelerated. The latter condition would demonstrate the falling of pressure in spite of the assistance of the heart, hence a greater degree of failure.

We may not perhaps with perfect accuracy be able to balance these two factors and determine how much a fall of 1 mm. in pressure signifies in terms of increase of heart beats a minute. We shall arrive approximately at the truth, however, if we assume that the respective limits of their total ranges coincide. We may then divide each total range into fractional parts each of equal significance and of balanced importance.

The total change of blood pressure in those who may be considered "in health," is from plus 10 to minus 10 mm. Hg. That of pulse rate is plus 5 to plus 35. We may divide our range into fifths and construct the following tentative scale, in which the letters constitute the index to the splanchnic efficiency:

| Blood-Pressure Increase:   |    | +10 | +5 | 0 | -5 | -10 |
|----------------------------|----|-----|----|---|----|-----|
| Increase in<br>Heart Rate: | 5  | A   | B  | C | D  | E   |
|                            | 12 | B   | C  | D | E  | F   |
|                            | 20 | C   | D  | E | F  | G   |
|                            | 28 | D   | E  | F | G  | H   |
|                            | 35 | E   | F  | G | H  | I   |

Interpreting this scale, we would have with an increase of 10 mm., if occurring with only five increase of heart rate, the index A, the best possible condition if accompanied with an increase of 35, and index of E, etc.

By the term splanchnic circulation we should properly mean the arterial branches of the celiac

axis, their branches and capillaries, with the radicles of the portal vein. This system is partly arterial and partly venous and it is to the venous portion that attention is to be called more particularly; the arterial portion and the capillaries present features very similar to like structures in other parts of the body whereas the venous portion presents features of extreme and novel importance. During the course of this work, however, when the splanchnic area is referred to, it will be understood that the portal vein and its radicles are meant particularly.

*The Capacity of the Splanchnic Area.*—The veins of the splanchnic area share with other veins of the body (which are not supported by rigid structures) the features of collapsibility. On this account the blood content of the total splanchnic area may therefore be very great or very small, in fact the veins alone may, under certain conditions, contain nearly all the blood of the body. Hill and Barnard<sup>1</sup> found in the dog, in the vertical, feet down, position that the cutting of the cervical cord causes the pressure in the aorta to fall to zero and practically the whole of the blood to be collected in the splanchnic area. Squeezing the abdomen brought back the aortic pressure to the normal. Hill worked with rabbits, suspending them without any operative interference in the vertical, feet down position; death invariably resulted in a short time. If the blood were kept from draining into the abdomen by a tight band, no inconvenience was suffered. If the rabbits were suspended in the head down position no bad result followed. These items serve to illustrate the great capacity of the splanchnic reservoir. The importance of this great capacity is demonstrated by the experiment of tying the aorta first below the celiac axis, and, secondly, above it, in an animal with



the cervical cord cut. In the first instance practically no effect on aortic pressure is observed, in the second a very considerable rise is obtained.—Ludwig and Thiry.<sup>7</sup>

*The Control of the Capacity of the Splanchnic Area.*—Nervous.—(1) Splanchnic nerves, (2) vasomotor center, (3) reflex stimulation. Mechanical—(1) External pressure, (2) tone of abdominal walls, (3) aspiration of thorax, (4) respiration.

1. *Splanchnic Nerves.*—Mall<sup>2</sup> observed the direct influence of the splanchnics upon the portal vein. He obtained a contraction of the vein that could be easily noted by the eye. V. Besold and Gscheidlen<sup>3</sup> proved much earlier that the systemic veins had a vasomotor system and were controlled in a similar manner to the arteries. These investigations prove conclusively a somewhat neglected fact that the veins of the splanchnic area have a tone as well as the arteries. That the splanchnic nerves are in the main vasoconstrictor in their function is shown by the dilatation of the splanchnic vessels on section of the nerves. This dilatation may be measured with some accuracy by the variations in the aortic pressure. The greater the room made for the blood in the splanchnic area, the lower the pressure will fall.

Hill has given the result of the action of the splanchnics in the experiment already quoted. Ludwig and Cyon<sup>4</sup> found that section of one nerve caused a fall of aortic pressure of 30 to 50 mm., the section of the other 8 to 10 mm. more. In every case the section was made by lumbar incision so that the opening of the thorax and abdomen were avoided. Asp<sup>5</sup> found that after section of both these nerves tone was partly regained in about two weeks, showing a taking

up of the function by other branches of the sympathetic system.

Bayliss and Starling<sup>9</sup> have found that the third to the eleventh anterior thoracic roots contain the fibers which affect the splanchnic area. By excising these roots they caused (1) an abrupt but ephemeral rise of pressure in the portal vein due to the constriction of the mesenteric arteries, (2) a fall, due to this same constriction, (3) a rise, due to the constriction of the hepatic branches of the portal vein.

According to Bever and v. Besold<sup>6</sup> section of the cervical or the upper dorsal cord does not produce any further material lowering of blood pressure after the splanchnics have been cut. V. Besold<sup>8</sup> found that by stimulation of the peripheral end of the cut cervical cord he was able to send up the blood pressure to seven times its normal height. Work by Hill and Barnard (*op. cit.*) would seem to indicate that since the splanchnic area was robbed of the support of the abdominal walls paralyzed by the section of the cord and not affected by the cutting of the splanchnics, we would expect therefore a greater filling of the veins and a greater decrease of pressure, after section of the cord than after section of the splanchnics alone. One of their experiments shows that with the splanchnics cut the blood pressure fell considerably when the abdomen was subsequently opened by a crucial incision.

2. *Vasomotor Center*.—The vasomotor center has been located in the medulla oblongata. It can be excited in two ways (1) by variations in the central blood pressure, (2) by reflex stimulation. A fall in cerebral blood pressure, *i.e.*, cerebral anemia, will cause a stimulation of the center, a consequent vasoconstriction and a rise

in pressure. A rise in cerebral pressure will cause the reverse.

There are subsidiary vasomotor centers in the spinal cord and even local centers outside the central system; on this account we may have local conditions of vasotone entirely independent of the general condition.

3. *Reflex Stimulation of the Splanchnic Area Through the Vasomotor Center.*—Any nerve, save the depressor nerve, when cut and the central end stimulated, will effect a stimulation of the vasomotor center and cause a rise in pressure. Some nerves, under certain conditions, are proven to carry depressor fibers and their stimulation will result in a fall of pressure. (Howell <sup>10</sup> Reid Hunt.<sup>11</sup>) The depressor nerve when stimulated will cause a marked lowering of blood pressure and a decrease in heat rate, through its effect upon the medullary vasomotor center.

*Mechanical Factors.*—We have already noted that the mechanical squeezing of the abdomen will increase the blood pressure in rabbits and dogs, in the vertical feet-down position. The writer has called attention to the same effect obtaining in man in the sitting position when the knee is crossed and the abdomen compressed mechanically by the leaning over. It was found in a subject in poor condition that the blood pressure in the radial artery (held at the height of the ensiform) was greater when the abdomen was thus compressed than when the erect sitting attitude was assumed.<sup>12</sup>

Rowe<sup>13</sup> has noted quite empirically that long-continued study cannot be accomplished when "sitting up straight," and that the characteristic attitude of study—bending over at a desk or bending over with the knee supporting a book is conducive to the success of long-continued work. The effects of attitudes are discussed by



Rowe and the blood pressures noted, and the results obtained would lead to the conclusion that the difference in mental ability noted by Rowe were due to blood pressure changes. Treves<sup>14</sup> has noted in enteroptosis that the symptoms often relieved by merely pressing upon the abdomen with the hands and that "many patients are unable to move about until they have adjusted their supports or bands." Bowen,<sup>15</sup> in a very complete work on the effect of exercise upon blood pressure, found that the pressure was raised during the whole of the exercise. Oliver<sup>16</sup> on the contrary found that while blood pressure was raised at first by exercise it fell rapidly if the exercise was continued. The difference in the results obtained by these two investigators is no doubt due to the difference in the exercise. In bicycling the position is somewhat flexed and the thighs press rhythmically upon the abdomen, by this means the splanchnic circulation is kept within bounds and the blood pressure is kept up. In walking, on the other hand, there is no such support and the blood drains rapidly into the splanchnic circulation. Oliver (*op. cit.*, p. 163) has proven conclusively the drain into the splanchnic area during continued exercise of this nature, namely, walking, and the fact that continued bicycling two hours and forty-five minutes does not allow of any drain. He found that after bicycling a pressure of twenty-two pounds distributed over the abdomen caused no rise in arterial blood pressure. After walking, on the contrary, one hour and thirty minutes, the same pressure caused a rise of 20 mm. The writer has verified these experiments. De Jager<sup>21</sup> finds that pressure on the abdomen has but little effect upon the abdominal arteries while it serves to express a large quantity of blood from the splanchnic veins.

*The Effect of the Tone of the Abdominal Walls Upon the Capacity of the Splanchnic Area.*—Hill and Barnard (*op. cit.*) have shown the value of the abdominal wall as a support to the circulation. In a dog suspended in the vertical, feet-down position, with the splanchnic nerves divided, the pressure fell markedly when the abdomen was opened. The slightest decrease in the tone of the abdominal walls will be followed by a decrease in intra-abdominal pressure. The cutting of the spinal cord for this reason causes a greater lowering of blood pressure than the mere cutting of the splanchnics, as has been already noted. Evidence is not wanting on this point. Treves (*op. cit.*) states that the greater part of the symptoms usually found with enteroptosis are due to the relaxation of the abdominal veins due to the decrease of intra-abdominal pressure caused by the loss of tone of the abdominal walls. Massage causes a direct emptying of the splanchnic vessels and an increase in blood pressure.<sup>17</sup> Quirin<sup>18</sup> finds that increase of intra-abdominal pressure brings up the pressure in the arteries merely by displacing the blood from the abdomen. Oliver (*op. cit.*) finds intra-abdominal tension decreased and associated with vasomotor inability, in many forms of impoverished nutrition, chronic goutiness, anemia and neurasthenia.

The action of the abdominal muscles in maintaining intra-abdominal tension and the means of testing their efficiency have been well worked over by Harry Campbell.<sup>19</sup> Campbell lays particular stress upon the function of the transversalis as a constricting band shutting off the upper from the lower abdomen. The recti are described as separated in the infant and nominally close in the adult. In the male in good health the abdomen is flattened by their action; in the female this takes place, but the contour becomes

rounded, due to the accumulation of subcutaneous fat.

*The Effect of Respiration and Aspiration of the Thorax Upon the Capacity of the Splanchnic Area.*—It is to be noted in Hill's experiment, previously cited, that opening of the thorax, after the splanchnic nerves had been cut, and the abdomen opened, caused a further fall of blood pressure; demonstrating the effect of the thoracic aspiration upon the return of blood from the abdominal veins. Leyden and Quincke<sup>20</sup> have found the negative pressure in the pleuræ to be as low as  $-42$  mm. Campbell gives the following table of minus pressures in the pleural cavity:

At the end of an extraordinary expiration.— 0  
 At the end of an ordinary expiration....— 5 mm.  
 At the end of an ordinary inspiration....—10 mm.  
 At the end of an extraordinary inspiration.—30 mm.

Donders<sup>21</sup> gives the following results:

In position of ordinary quiet inspiration...—9 mm.  
 In position of ordinary quiet expiration.....—7.5  
 In position of deepest inspiration.....—30 to 40

This minus pressure is due to the elasticity of the lungs pulling against the comparatively rigid chest wall. This pull or suction has wide variations. In the infant it is practically nil, as the lungs fit the chest cavity with little or no tension of stretching. In old age the lung ordinarily becomes permanently stretched and fails to produce the suction evident in ordinary conditions. All organic diseases of the lungs—bronchitis, pleurisy and tuberculosis—diminish it, and in emphysema, it is reduced to a minimum. In fevers, as in typhoid and diphtheria, it is diminished. The bulging of the chest in pneumonia is due not ordinarily to a positive internal pressure, but to a diminution in the negative pressure.

This elasticity of the thorax is a factor in de-



termining the amount of pulmonary suction actually efficient upon the circulation of the abdomen. The suction cannot be greater than the elastic resistance of the thoracic wall. In early youth this elasticity is greatest and the negative pressure lowest. It is at this time that any weakening of the thoracic wall from malnutrition gives us the familiar result of a depressed sternum, and its exaggerated form, the "Trichterbrust." In adult life, however, the rigidity of the chest wall has become established, pulmonary suction is finally resisted, and becomes effective, as a potent factor not only in causing the upward flow of blood from the splanchnic area, but in causing the return of the lymph and the blood from the azygos and upper body veins.

It is evident that the variations in the negative pressure of the chest cannot fail to cause variations in the rate of inflow of blood to the thorax. We shall expect during inspiration an increased inflow, and during expiration a decreased inflow; also, owing to the same reason, we should have a decreased outflow during inspiration and an increased outflow during expiration. This should cause the chest to contain more blood at the end of inspiration than at any other time. Heger and Spehl found that the lungs contained 1-13 to 1-12 of the total blood in inspiration, and only 1-15 to 1-18 in expiration. Hill<sup>24</sup> concludes that "in natural breathing the air and the blood volume change together and in the same way."

From the foregoing facts it is evident that the respiratory mechanism is most potent in returning blood from the splanchnic veins.

*The Effect of Variations in Splanchnic Capacity Upon Blood Pressure.*—Arterial blood pressure depends primarily upon the force of the heart beat, the volume output per beat, the

rate of beat, and the peripheral resistance. Turning to the cardiac conditions alone we should observe that, other things being equal, the greater the output per beat the greater will be the arterial pressure; also, the greater number of beats per minute the greater will be the pressure.

All combinations of these factors are possible. The stimulation of the vagus will cause a slower beat and a diminished output per beat. By stimulation of the accelerator nerves in the dog, Woolridge<sup>25</sup> obtained an increase of output per beat and a consequent rise in pressure without any acceleration. Munzel<sup>26</sup> and Roy and Adami<sup>27</sup> obtained an acceleration of the heart without any increase in blood pressure.

Roy and Adami (*op. cit.* and <sup>28</sup>); Howell and Donaldson (*op. cit.*); Tigerstedt<sup>29</sup> and others have found that the heart output depends largely upon the amount of blood available to the heart in the great veins. Anything increasing this amount of available blood causes a rise in pressure. Abdominal massage, abdominal constriction, muscular exercise, etc., all cause this result by constricting the splanchnic area.

Any factor causing a decrease in splanchnic tone, such as warm baths, fatigue, disease, exercise (second stage) will cause a lessened venous inflow, a decreased output and a lowered blood pressure.

The importance of this mechanism in controlling the blood pressure has but recently been exploited, and has hardly reached the text-book stage. That the splanchnic mechanism is a most potent one, may be seen by the fact that excitation of the splanchnic nerves will produce a greater arterial pressure than the closure of the thoracic aorta with a clip<sup>30</sup>, and also by the fact that the complete failure of its vasoconstriction means the collection of practically all the

blood of the body within its veins. Recent work by Romberg and Pässler,<sup>31</sup> and Pässler and Rolly,<sup>32</sup> goes to prove that death from diphtheria and pneumococcus septicemia is due not to cardiac failure, as hitherto believed, but to vasomotor paralysis, and that the heart at death is still able to contract. Patients may thus be treated with vasoconstricting elements, instead of cardiac stimulants.

*The Method of Using the Test.*—The patient is directed to lie down flat upon a couch with no head rest. The armlet of the blood pressure instrument is then placed around the upper arm. This should be arranged so that it bears the same relation to the heart lying as it will when the patient is standing, so that no hydrostatic error will be included. Absolute quiet is insisted upon, relaxation of the muscles is necessary, and all emotional disturbances should be guarded against. The pulse rate is then taken by quarter minutes for at least four successive quarters. These should be recorded until we arrive at a plateau in which the heart is steady, the indication of which may be taken to be the point where four records show no decrease. These four records forming a minute's record should be noted for comparison with the standing rate. Without releasing the grip on the radial artery, the systolic pressure should be taken.

This should be taken twice, and if any large difference is noted, a third time; and the average struck. If there is any considerable variation noted, it may be due to several disturbing factors, such as an uncomfortable position, emotional disturbances, nervous muscular contractions, holding the breath, etc., all of which should be eliminated. These items recorded, the patient is allowed to stand and the same records taken in the same way with the same precautions.



It is important that the pulse rate should be allowed to fall to its standing normal after rising, for it is accelerated by the muscular act of getting up. The blood pressure also rises considerably at first (though it may fall), but it strikes a balance as a rule a little before the pulse rate does. We may now compare our results and arrive at a conclusion as to the condition of the individual. The whole test takes less than five minutes.

It is advisable at first to repeat the test and corroborate the findings of the first examination; with a little practice, however, a repetition is unnecessary.

*Range of Results.*—In “normal” cases the heart rate increase varies from 0 to 43, the systolic pressure from plus 18 to minus 12, the diastolic, from 0 to plus 18. Various combinations of these have occurred. The usual combinations are “regular”—that is, the rise in systolic pressures is in inverse ratio to the rise in the pulse rate; both factors being equally significant, for good or for bad.

*Case I.*—A., aged eighteen years; football player; weight 185 pounds; very muscular; 10:30 A.M.:

|                             | Pulse rate. | Systolic Pressure. |
|-----------------------------|-------------|--------------------|
| Lying .....                 | 58          | 120 mm.            |
| Standing .....              | 58          | 132 mm.            |
| Difference .....            | 0           | +12 mm.            |
| Estimation as per scale A+. |             |                    |

This shows the least possible increase in pulse rate, viz.: Zero with nearly the greatest possible increase in systolic pressure.

*Case II.*—S., aged thirty-five years; a teacher, athletic, “in good shape,” after the school day, 3 P.M.:

|                            | Rate. | Pressure. |
|----------------------------|-------|-----------|
| Lying .....                | 61    | 110 mm.   |
| Standing .....             | 85    | 110 mm.   |
| Difference .....           | +24   | +0        |
| Estimation as per scale E. |       |           |

This case shows a considerable rise in heart rate, 24, approximately, the middle of the scale and coupled with it no change in pressure; also a middle term.

*Case III.*—V., aged seventeen years; quarter-back football team, "in good shape," according to his own statement; weight 125 pounds. At the end of the football season, 11.20 A.M., twenty minutes after a recorded amount of exercise:

|                            | Rate. | Pressure. |
|----------------------------|-------|-----------|
| Lying .....                | 68    | 100 mm.   |
| Standing .....             | 104   | 94 mm.    |
| Difference .....           | +36   | -6 mm.    |
| Estimation as per scale H. |       |           |

This case shows very great increase in pulse rate and a considerable decrease of pressure. A "regular" variation, and a very poor record.

In these cases just cited, each factor is proportionately as "good" or "bad" in its significance as the other. If this were the invariable rule it would be necessary to record but one of these factors, for the other would be easily calculated as in inverse ratio to it. This, however, is not the case, as the following "irregular" cases show:

*Case IV.*—S., aged seventeen years; athlete, weight 140 pounds; 11 A.M., "not feeling very fit," coffee with breakfast; walked one and one-half miles to school and took two periods of hard school work, one standing in laboratory.

|                  | Rate. | Pressure. |
|------------------|-------|-----------|
| Lying .....      | 64    | 128       |
| Standing .....   | 72    | 118       |
| Difference ..... | +8    | -10       |
| Scale E.         |       |           |

This shows a slight increase in pulse with a marked fall in pressure. A "good" pulse rate increase with a "bad" fall in pressure.

*Case V.*—B., aged sixteen years; athlete, weight 130 pounds; somewhat overtrained; 11 A.M., simple breakfast, no exercise, two periods of easy school work.

|                  | Rate. | Pressure. |
|------------------|-------|-----------|
| Lying .....      | 68    | 100       |
| Standing .....   | 104   | 110       |
| Difference ..... | +36   | +10       |

Showing a great increase in rate—a bad feature; coupled with a considerable increase in pressure—a good feature.

*Validity of Results.*—A test of this sort can only at present be proven by empirical methods, and to these we must resort. There is no other way known to the writer whereby the efficiency of the splanchnic mechanism may be determined by which a comparison of results and a proof might be established. We can, however, test the efficiency of the individual and observe how nearly he will follow out our predictions as regards his "condition" in his athletic and other work. Should a man work poorly after this test has shown him an "A," with splanchnic mechanism presumably in good order, we should have cause to doubt the validity of the test. Also should a man whose record places him an "E" or below show up well, in athletic events or other strenuous work, we should again have reason to doubt our test. Such is not the case.



Without exception the athletes who have so been tested by this method have *invariably and fatally carried out predictions*, even though ignorant of the meaning of the test.

A second method more easily followed out is the testing of these individuals whose condition and general efficiency is approximately known. Here, though we may meet with some surprises, the following are several cases typical but in no way selected:

1. In V., already cited as Case III, whose record was taken four times during the course of the day, his index ran G, G, H and H—during the day, his pulse increased 28, 36, his pressure fell from —2 to —12 at different times. On being questioned it appeared that he had not been sleeping very well, though he was in “good shape.” He begged off from his physical training work of the afternoon and was absent the next week, having “caught cold and a fever.”

2. Case VI.—T., teacher, aged thirty-two years; weight 190 pounds; athlete. Had six hours' sleep, hurried breakfast, “fair shape”; one of the twenty best tennis players in the United States, gave a record of +27 rate, and +6 mm. pressure at 8:30 A.M.; +19 rate and —0 mm. pressure at 3 P.M., both equal to E index. Played tennis at 4:15 to 6:15 with a very much inferior player; won the first two sets at 6—0, 6—3, lost the next three 6—8, 3—6, 0—6, demonstrating very conclusively his lack of “staying qualities” on this particular occasion.

Case S., quoted at Case II.—Ran three blocks after a car one-half hour before test, and felt somewhat dizzy on standing. “In poor shape,” though a “10 2-5 man” in the hundred yards dash five years ago. At 8:30 A.M., pulse rate

increased +36, pressure —12 mm., passed a miserable day, not feeling well.

*Case VII.*—F., coach of track team; fair athlete; "in fine shape." Test at 10:30 A.M., and gave an index F, with increase of rate +20 and pressure —7. A few days afterward ran a 220-yard dash; this was followed by a mild case of collapse, with the usual unloading of the stomach afterward.

These and many other cases show decisively that the estimations of poor "condition" are accurate. On the other hand, estimations of good condition have proven equally accurate.

The condition A is a somewhat unusual one, only three cases were found in an investigation of 38. One was Case I, already cited, the full-back of a football team, whose work shown as particularly successful on a very successful team. He was practically untiring, was never "laid out," and was a remarkable player in every way. The second was an assistant director of physical training who kept in the best of condition and was remarkably "long winded" in continued work, as in wrestling and basketball.

The third was a young man, a student of good, though not unusual mental and physical ability, a member of the track team, whose work was principally on the long runs, where he showed not a great deal of speed, but a consistent ability "to keep at it," though he was apparently not very strong.

Aside from this method of proving the validity of the test we may seek to prove it by taking individuals of a known condition and observe the correspondence of the results. This has been used and has given much information concerning the accuracy of the test. In a few cases where the findings of the test disagreed with the condition as predetermined, the case was not

made out clearly in favor of the empirical methods, whereby the first estimation of condition was made. In several of these particular cases subsequent observations on these patients demonstrated the accuracy of the test as against the other methods used.

An interesting and an important item of proof of the validity of the construction of the scale and the balancing of the two factors was brought to light in an investigation on the condition at different periods of the day. It was found that in most cases the condition gradually became worse during the day, but each of the two factors might show a wide variation. The following case is typical:

*Case.*—R., aged seventeen years; member of track team, one mile, not very good runner but able to "finish" well. (See table on next page.)

*Medical Aspects of the Test.*—By the use of this test we can estimate in a real way the progress made in our chronic cases and the value of the remedies applied. It is inapplicable to any but ambulant cases, for rest in bed interferes with it strongly. A moderate amount of rest

|            | Increase in<br>Pulse Rate. | Increase in<br>Systolic<br>Pressure. | Index. | Remarks.                                   |
|------------|----------------------------|--------------------------------------|--------|--------------------------------------------|
| 9:45 A.M.  | 0                          | +10                                  | A+     | Slept well, no exercise.                   |
| 10:50 A.M. | 0                          | +4                                   | A—     | After a lesson in physics.                 |
| 11:45 A.M. | +8                         | +12                                  | A—     | After lesson in algebra.                   |
| 12:20 A.M. | +5                         | +6                                   | B      | After lesson in French.                    |
| 1 P.M.     | +4                         | +15                                  | A      | After lunch and rest; no<br>coffee.        |
| 2 P.M.     | +14                        | +16                                  | A—     | After history lesson.                      |
| 2:25 P.M.  | +16                        | +8                                   | B—     | After one-half mile slow<br>run.           |
| 2:30 P.M.  | +18                        | +8                                   | B—     | Fifteen minutes hard exer-<br>cise.        |
| 2:38 P.M.  | +18                        | +8                                   | B—     | After five minutes rest,<br>feeling tired. |



in the run-down will increase the efficiency of the vasomotor mechanism, but long-continued rest decreases its efficiency, from disuse, to a marked extent. The fall of cerebral pressure and consequent syncope caused by even the sitting up in bed of a patient long recumbent is familiar to all. Its chief use in future will no doubt be in diagnosis of the amount of damage to the general vitality any hidden disease or any course of life has produced in the patient under our observation for the first time and also in the estimation of the progress made under our management.

In the guidance of our therapeutics we may look for a field of usefulness. It is not enough to know how a drug affects the blood pressure, which is but vague information, we must know how it affects that most important function, the vasomotor control.

The writer has applied this test to a number of hard-worked business and professional men who have come under his care, with most satisfactory results. In every case it formed an accurate and reliable index to real improvement. It was very much more steady in its readings than would be expected from the apparent variations in observed condition, which were extremely variable, but it seemed to check real improvement much more positively than could be determined by observation.

In one case of neurasthenia, in which a relative degree of sexual impotence was a symptom, the index followed the regaining of this function very exactly, and marked a relapse as accurately.

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